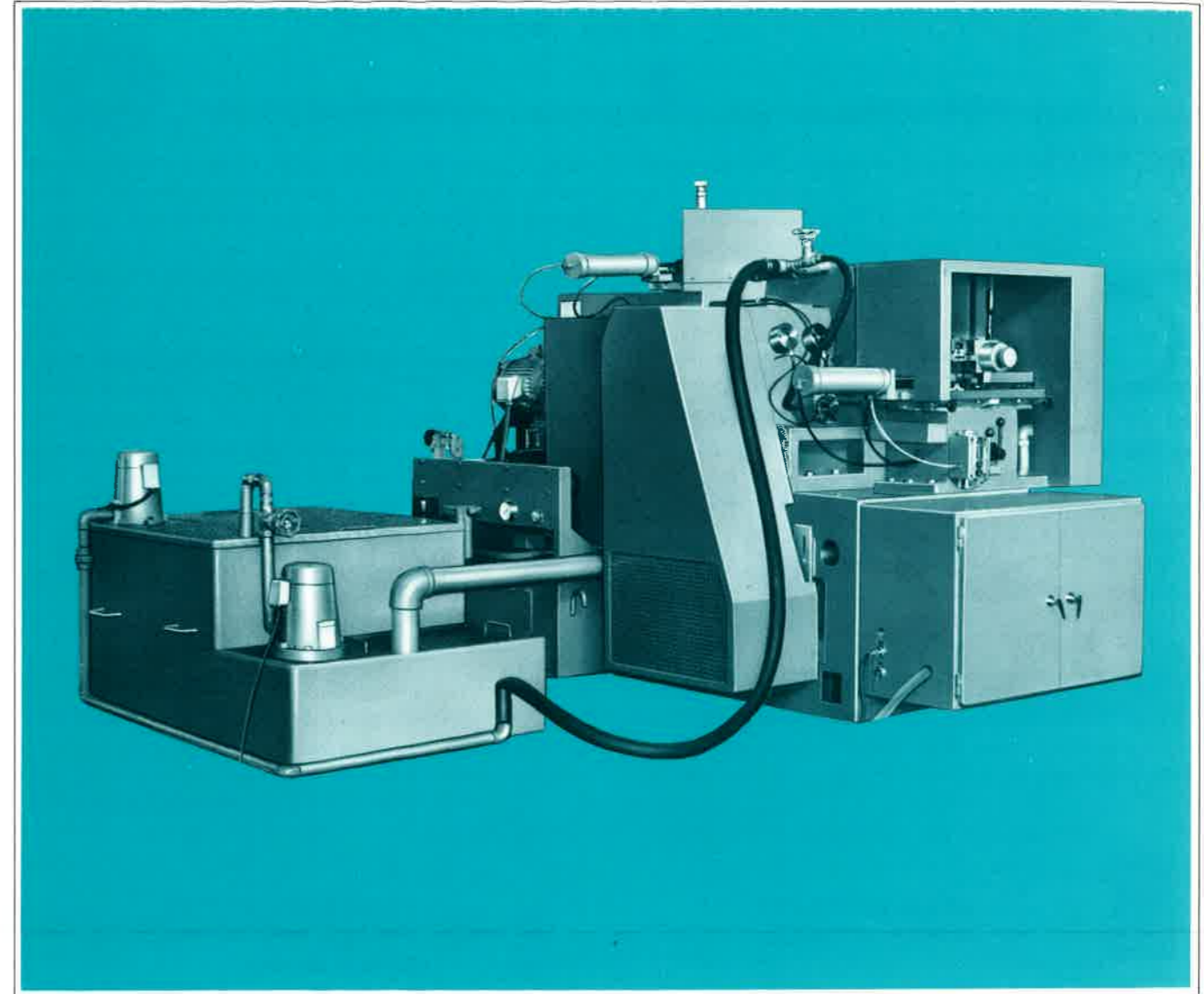
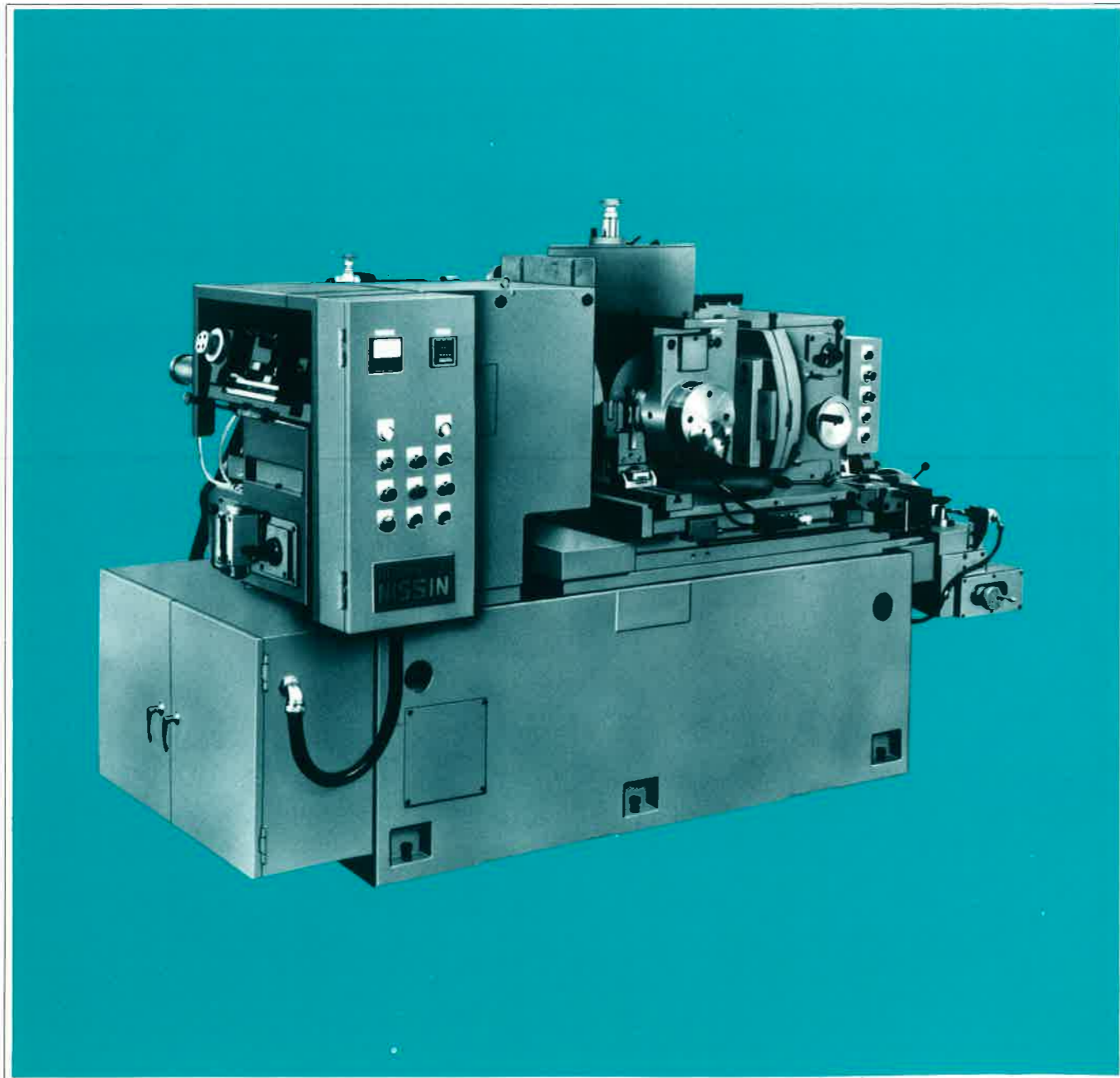


High Speed Hydrostatic Centerless Grinder

# HI-GRIND<sup>®</sup>-2



## FEATURES

1. Hydrostatic Bearings fully applied, thus realized wear-free centerless grinding machine with no stick-slip.
2. Rigid machine structure, enables heavy duty grinding and high precision grinding as well.
3. High Speed Grinding improves surface finish and wheel life.

# HI-GRIND<sup>®</sup>-2 Main Advantages;

Fully applies hydrostatic bearings and represents our long experience of centerless grinding manufacturing.



## HYDROSTATIC BEARING

The spindles are supported by pairs of opposed hydrostatic bearings. Full film of pressurized lubricant separates the spindle from the bearing pads even at zero speed. Hydrostatic bearings offer advantages as follows;

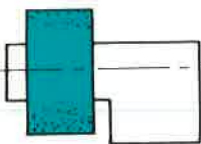
1. No frictional drag,
  2. No friction and low temperature rise,
  3. Constant rotating accuracy,
  4. High film stiffness independent on the number of rotation.
- For these reasons they have been successfully applied on high speed grinding wheel spindle and infinitely variable speed regulating wheel spindle.



## HYDROSTATIC GUIDE WAY

Pressurized lubricant is supplied between the sliding surfaces. The full film of the lubricant with constant thickness supports the table. As the film thoroughly separates the sliding surfaces, there is no metal-to-metal contact. Hydrostatic guide ways have following merits;

1. No friction and no stick-slip,
2. Precise and fine feed,
3. Deflection free rotation and needs no adjustment and overhaul.



## RIGID GRINDING WHEEL SPINDLE

Open sided support is applied, and the front bearing is extended inside of the wheel mount. Simplified bearing structure enables the spindle to have 125φ diameter. Since the oil film rigidity comes up to 200 kg/μm, the spindle rigidity is several times larger than conventional machines. In spite of high rotating speed, the temperature rise of HI-GRIND is much lower than conventional machines.



## PUSH BUTTON FINE INFEEED OPERATION (special device)

Fine compensating unit is driven by a micro motor, and feeds the table 1 μm/push. Hydrostatic guide ways realized the precise infeed, and made it possible to compensate the size during grinding operation. With a ball infeed screw 0.5 μm/push is also possible. This operation allows the improvement of performance, handling, and high efficiency.



## RIGID REGULATING WHEEL SPINDLE

This spindle is supported at both ends. For dismantling the regulating wheel, remove the front bearing housing. Very fine alignment can be obtained as the finishing of the housing has been done after fitting up. Both journal bearing diameters are 100φ and this hydrostatic bearing enables constant rotating accuracy. Rigidity of regulating wheel spindle is one of the main features which assures highly accurate result on HI-GRIND-2.



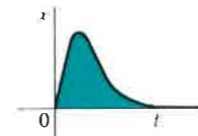
## MACHINE BED

To increase rigidity, machine structure must be solid enough with careful arrangement. HI-GRIND-2 is well designed to obtain higher rigidity. Applying the hydrostatic guide ways to the bed, the machine structure of HI-GRIND-2 has very high damping characteristics. This sealed-box-type bed structure is well considered for the cutting fluid flow and slides protection.



## HIGH SPEED GRINDING

Standard surface speed of HI-GRIND-2 is 45 m/sec. And 60 m/sec. is available. This surface speed is enabled by the development of low frictional spindles & increasing rigidity of the machine. Through high speed grinding, surface finish and wheel life are improved. And yet by means of infeed heavy duty grinding, high efficiency grinding can be attained. Motor capacity is 20 HP and 30 HP\* that is twice larger than conventional machines. Large motor capacity assures precise grinding & heavy duty grinding.



## HIGH DAMPING

Important parts such as spindles & bearings, table & bed are combined through hydrostatic film of lubricant. And this film absorbs machine vibration. Damping characteristics of entire machine is raised and contributes to improve dynamic stiffness. The film further serves to insulate outer vibration. High damping of the machine is one of the most important conditions to assure constant roundness.



## OPERATIONAL CONVENIENCE

Operational convenience of this medium size machine is well considered.

1. Push button operated R. wheel fine infeed (special device),
  2. Easily variable R.P.M. of regulating wheel,
  3. Regulating wheel head table can be swivelled, and easier adjustment of wheel contact with works.
  4. Practicable workrest for wide range of works,
  5. Availability of various attachments and devices.
- \* According to customer's workpiece, any required degree of automation is applicable.



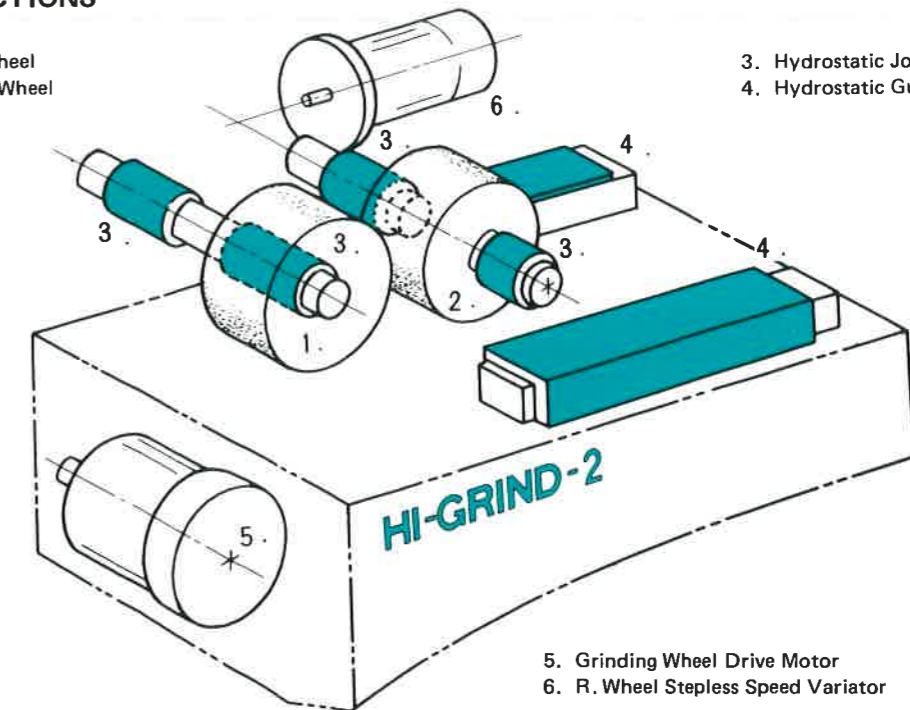
## SAFETY ASPECTS

"Standards for grinding machine structure" published by labor ministry prescribes the safety and care of grinding machines & wheels. HI-GRIND-2 of course meets these standards. Wheel guard must absorb the shock caused by wheel burst. Wheel guard on HI-GRIND-2 is designed in accordance with the experiences gained from cautious tests against wheel burst.

## MAIN CONSTRUCTIONS

1. Grinding Wheel
2. Regulating Wheel

3. Hydrostatic Journal Bearings
4. Hydrostatic Guide Ways

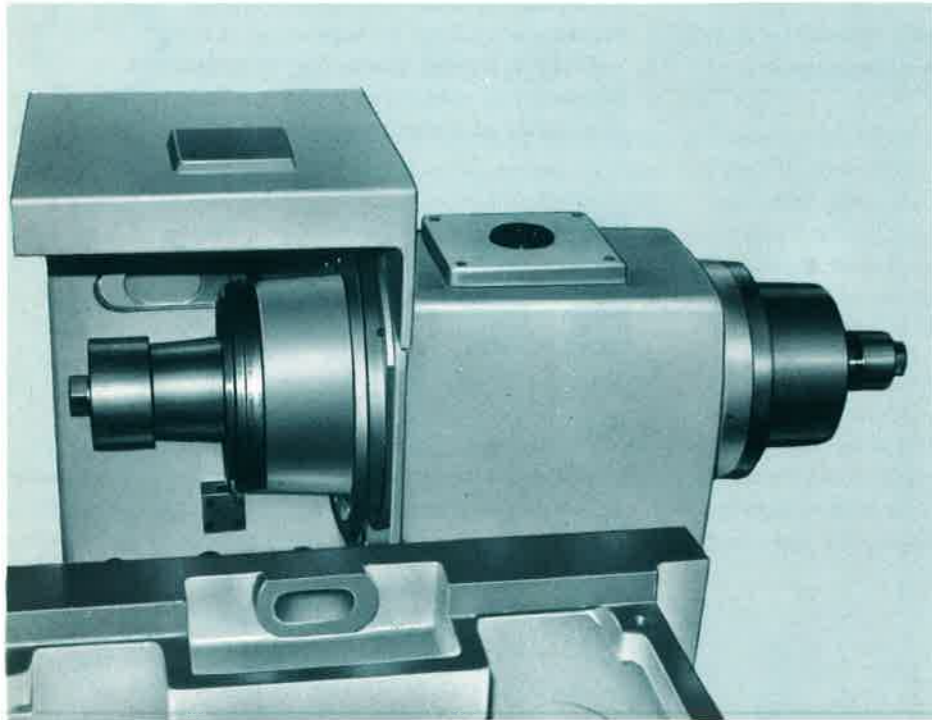


5. Grinding Wheel Drive Motor
6. R. Wheel Stepless Speed Variator

## GRINDING WHEEL HEAD

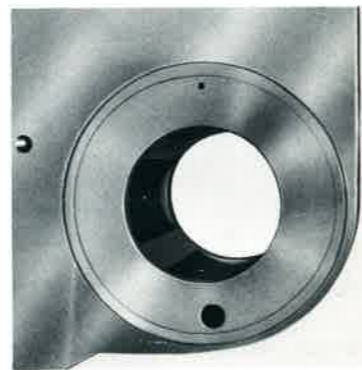
Hydrostatic bearings support the grinding wheel head.

Smoothness of ball bearings and performance of the plain bearings are combined in the hydrostatic bearings and realizes absolutely rigid bearing structure.



← MASSIVE GRINDING WHEEL HEAD

HYDROSTATIC BEARINGS



For high speed grinding, wheel head must be properly designed.

When the wheel surface speed is doubled, temperature rise in the bearings and the exciting force caused by unbalance would be four times increased.

Grinding wheel head must be of low friction and high rigidity.

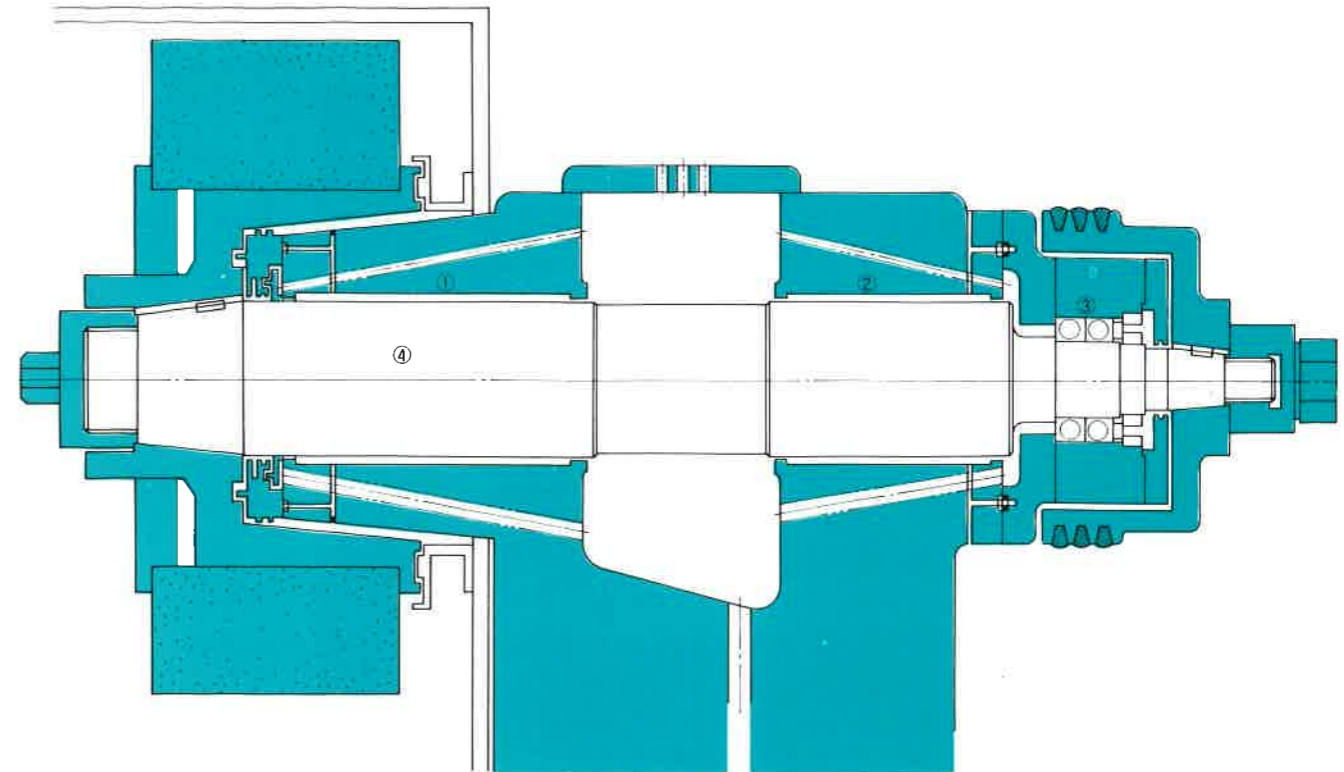
So far as the plain bearing has the limitation for this sphere.

The hydrostatic bearings adopted to HI-GRIND realized low frictional drag and high rigidity.

They are the most suitable bearings for high speed grinding machines.

## GRINDING WHEEL HEAD STRUCTURE

1. Hydrostatic Journal Bearings
2. Hydrostatic Journal Bearings
3. Angular Contact Ball Bearings
4. Grinding Wheel Spindle

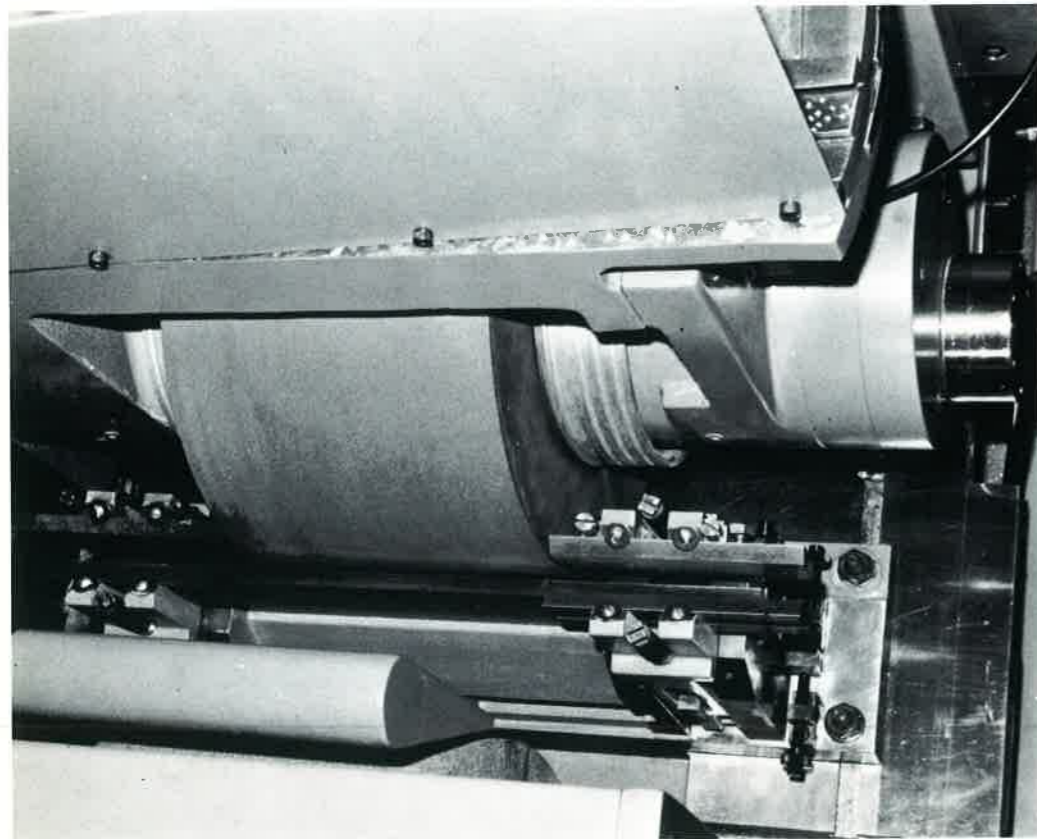


### ADVANTAGES

1. Grinding wheel spindle is made of nickel chrome molybdenum steel. Manufacturing process of spindle from heat treatment to mirror finishing is kept under severe control.  
125 mm $\phi$  spindle is as rigid as roll grinder spindle. And its stiffness is in proportion to diameter  $\phi^4$ .
2. Although the spindle is supported at one end, front bearing is extended inside of the wheel mount so as to support the grinding force directly. Distortion of the spindle is minimized by this design.
3. Length of front and rear bearings is total 400 mm, and projected area of whole bearings is up to 500 cm<sup>2</sup>.  
This entire area acts efficiently as the spindle bearing. Therefore spindle rigidity with this bearings is several times larger than the spindle with plain bearings.
4. Also this spindle bearings have the general advantages of hydrostatic bearings as follows:
  - (a) No frictional drag. As the pressurized lubricant is supplied from the outer circuit, and spindle is supported by pairs of opposed hydrostatic bearings, there is no metal-to-metal contact even at zero speed.
  - (b) Low temperature rise. It is possible to keep the temperature rise as low as that of ball bearing, if proper design is adopted. Cooling of lubricant is not required except for very precise grinding operation.
  - (c) Full film of the lubricant helps to average bearing performance and can get much better rotational accuracy than the spindle accuracy. Even 0.1  $\mu$ m rotational accuracy can be obtained.

## REGULATING WHEEL HEAD

Both spindles are the most important factors of centerless grinder.  
Regulating wheel head of HI-GRIND is supported at both ends by hydrostatic bearings,  
and is as rigid and accurate as the grinding wheel spindle.

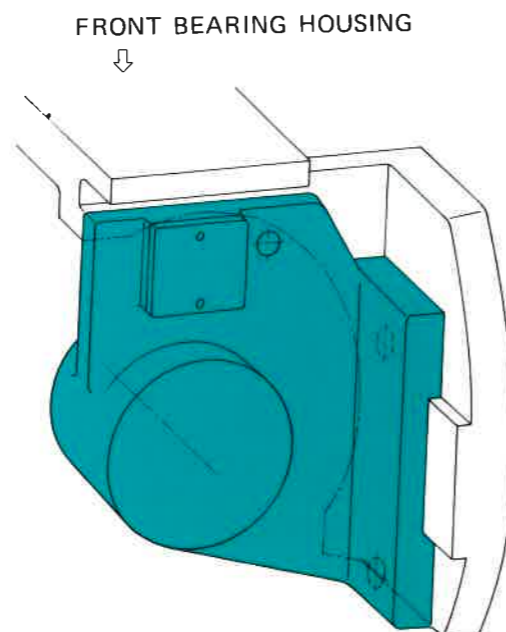


← REGULATING WHEEL HEAD

Regulating wheel spindle is supported at both ends by the 100 mm diameter hydrostatic bearings. To dismantle the regulating wheel, remove the front bearing housing.  
Front bearing block is fitted to front and side surfaces of the housing, and fixed by three precise  $20\phi$  taper pins. Very fine alignment can be obtained as the processing has been done after fitting up. Advantages of hydrostatic bearings are;

1. No metal-to-metal contact at any operating speeds (incl. zero speed), thus they have extremely low friction.
2. High load carrying capacity at slow speed. Rigidity is independent on the number of rotation.
3. Fine rotating accuracy. As the spindle is supported by full film of lubricant, average bearing performance is very effective.

It is not hard to get  $0.1 \mu\text{m}$  rotating accuracy.



FRONT BEARING HOUSING

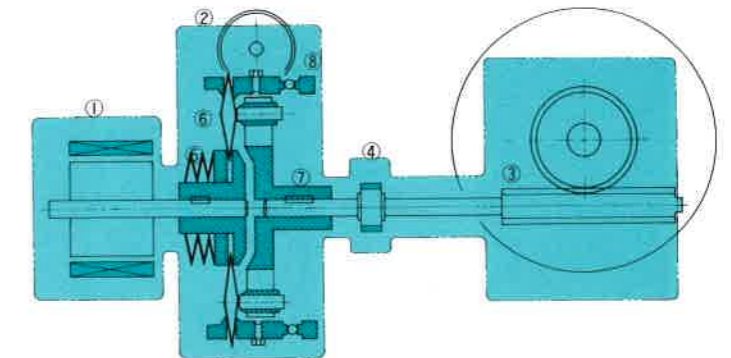
## REGULATING WHEEL DRIVE

Regulating wheel is driven by mechanical infinitely variable speeds. This mechanism allows to change the speeds whilst rotating the regulating wheel.

Regulating wheel is driven by a stepless speed variator and final reduction gears. Speed range of 1 : 12 can be obtained. Differential gears as shown on the figure are adopted to this stepless speed variator. Mechanics of this variator is designed more compact and longer life than usual variator. A chain coupling with torque limiter is equipped, which guards the drive mechanism when the regulating wheel is unusually over-loaded.

Standard type machine is equipped with 4 and 8 pole motor.  
However 2 and 4 pole motor is available for needle roller grinding machine.

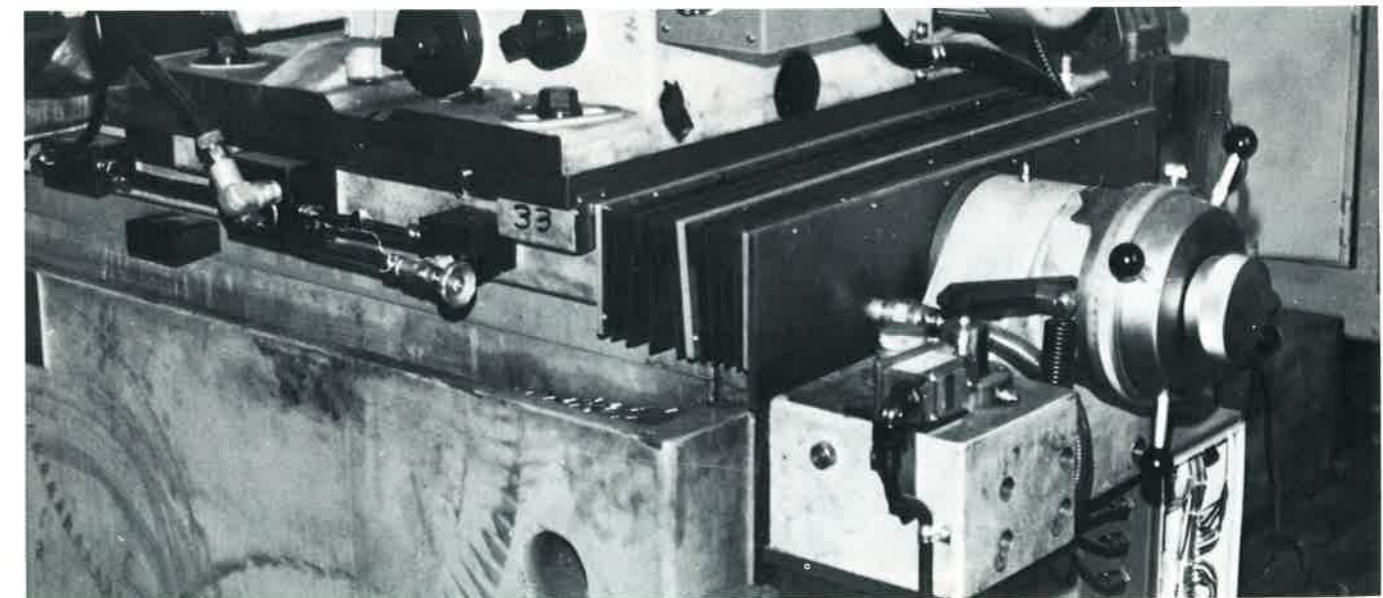
STEPLESS SPEED VARIATOR



- |                                       |                      |
|---------------------------------------|----------------------|
| 1. Motor                              | 5. Input Shaft       |
| 2. Stepless Speed Variator            | 6. Planet Gear Shaft |
| 3. Worm Reduction Gears               | 7. Output Shaft      |
| 4. Chain Coupling with Torque Limiter | 8. Fixed Axle        |

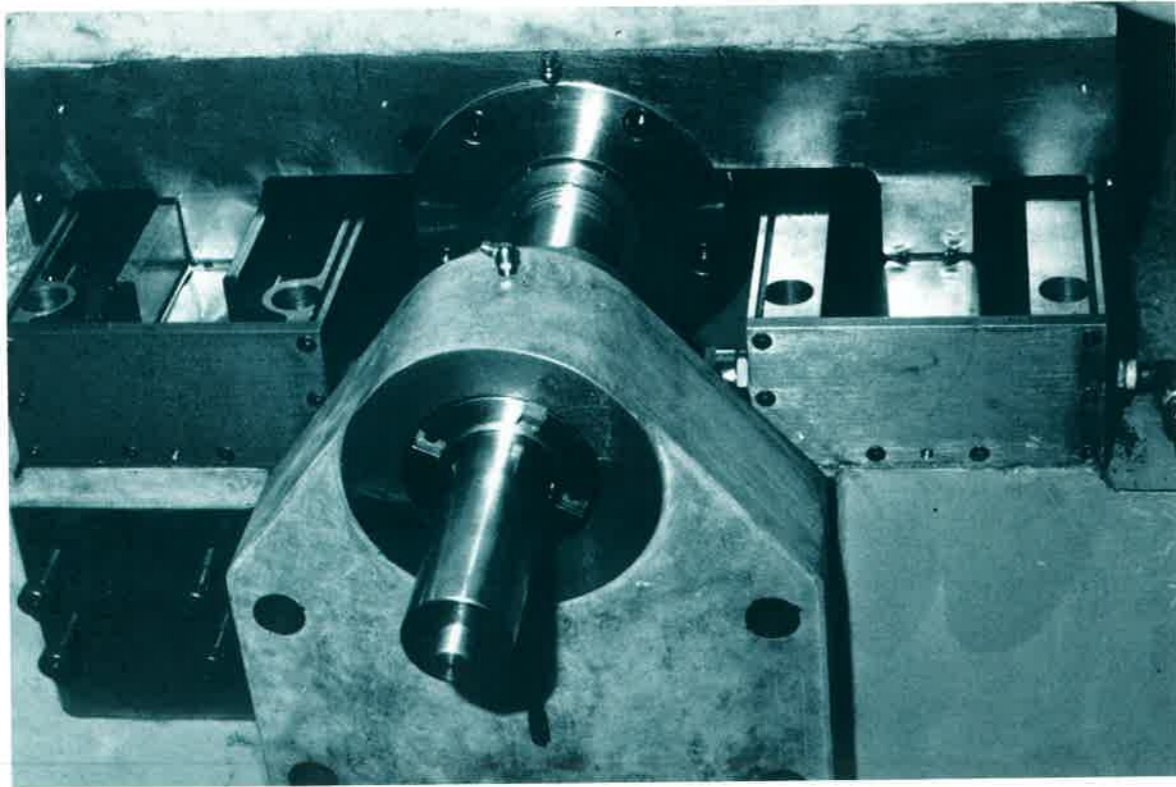
## PUSH BUTTON FINE INFEEED DEVICE (special device)

Fine compensating unit is driven by a micro motor and feeds the RW head table  $0.001 \text{ mm/push}$ . With a ball infeed screw  $0.0005 \text{ mm/push}$  is also available.



## HYDROSTATIC GUIDE WAY

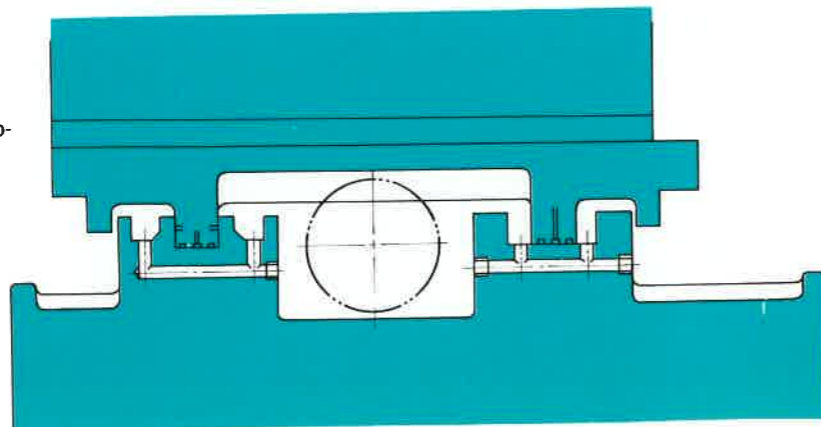
Moves so smooth as can be pulled even by a hair and permits extremely fine infeed rate (0.0005 mm) without stick-slip.



Regulating wheel head weighted about 1 ton is supported by the full film of lubricant. Table is supported by the double film bearings for the horizontal direction, and for the vertical direction by the single film bearings. As the rigidity of single film bearing is balanced with the weight of RW Head, RW table will not be lifted by upward force. Grinding force is transmitted to the bed through the thrust bearings. 60φ large diameter screw is applied. And the pre-loaded thrust ball bearing is subjected to the bearing force.

### GENERAL ADVANTAGES OF HYDROSTATIC GUIDE WAYS

1. Without stick-slip. Frictional resistance alone exists in this guide way. And this frictional is proportional to the velocity.
2. Fine increment of even  $0.5\mu\text{m}$  can be obtained by a suitable design of infeed device.
3. As there is no metal-to-metal contact, sliding surfaces are free from the wear. Require no additional adjustment and over-haul.



## AUTO-CYCLE DEVICES

By adding these valuable devices, our centerless grinding machine will increase its ability.

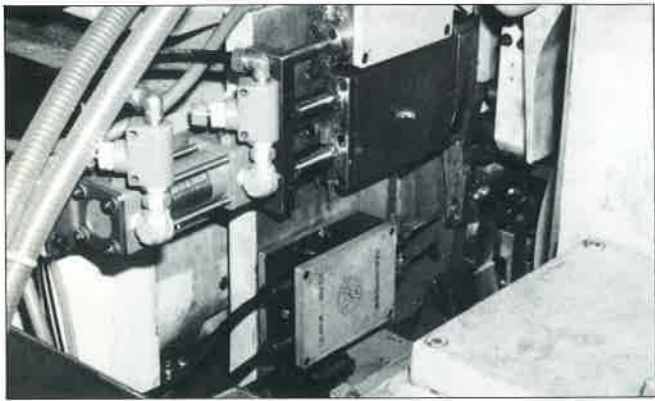
<b>Auto-loader</b>	Performs loading and unloading of workpieces to the grinding groove. Depending upon application, air, oil or electric motor is selected for drive force. To achieve maximum efficiency, loader is designed and manufactured for each workpiece.
<b>Auto-infeed Device</b>	Performs infeed of RW head table. Air, oil and electric motor are available for drive force. Controlled by mechanical auto-cycle with cam and limit switch or inprocess gauging cycle.
<b>Auto-dressing Device &amp; Compensation</b>	Performs dressing of Grinding Wheel with pre-determined interval. According to this, RW head table is compensated. Also, wheel wear compensation is performed automatically.
<b>Auto-taper Control Device</b>	In infeed grinding, taper adjustment is sometimes required. On conventional machine, it is enabled by swivel adjustment of RW head table. This device performs the adjustment by swivel movement of RW spindle in the bearing housing. Automation is possible. For automated operation, post-process gauge is necessary.
<b>Post-process Gauge</b>	Inspects ground parts and signals to the machine for compensation. The signal feeds back to compensating device of RW head table. Usually used with auto-compensation device. (TSK or MARPOSS gauges are applied)
<b>In-process Gauge</b>	Inspects part continuously during grinding and controls infeed cycle. In this case, each part is ground to the required size by gauge control. So, this method has a large advantage that even after dressing, no NG parts will be produced.

### VARIOUS COMBINATIONS

No.	Devices	No.	Devices
1	machine + loader + infeed device	5	machine + loader + dress compensation + post process gauge
2	machine + loader + dress compensation	6	machine + loader + infeed device + dress compensation + inprocess gauge
3	machine + loader + infeed device + dress compensation	7	machine + loader + infeed device + dress compensation + inprocess gauge + post process gauge
4	machine + loader + dress compensation + postprocess gauge	8	machine + loader + dress compensation + inprocess gauge + post process gauge + taper control device

# AUTO-GAUGING CYCLE

Inprocess gauge and Post process gauge are the two types of sizing devices.

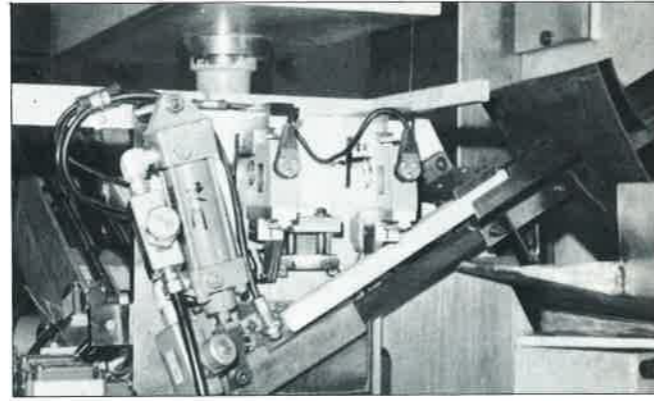


## Inprocess Gauge

This gauge inspects parts continuously during grinding operation and puts out signals. These signals control the movement and speed of RW head infeed device. It is also possible to warn the wear of blade and regulating wheel.

● Important Items

1. RW head table infeed should be very smooth and without stick-slip.
2. Infeed device should correspond to signals quick and accurate.
3. Infeed cycle time should be stable.
4. Items (1, 2, 3) should not deteriorate for a long time.
5. Diameters not inspected by gauge can not be guaranteed. It depends on the stability of the machine & workpiece specification.



## Post Process Gauge

This gauge inspects the ground diameter of parts.

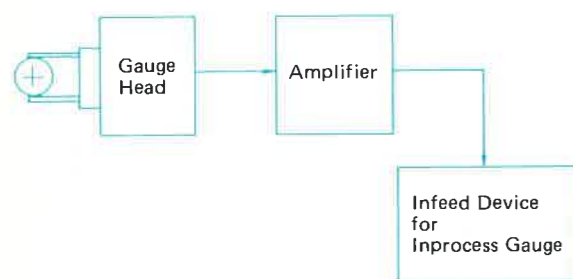
The signals are used for;

- \* size measuring
- \* size control
- \* taper control (D1 - D2)
- \* control of auto-loader

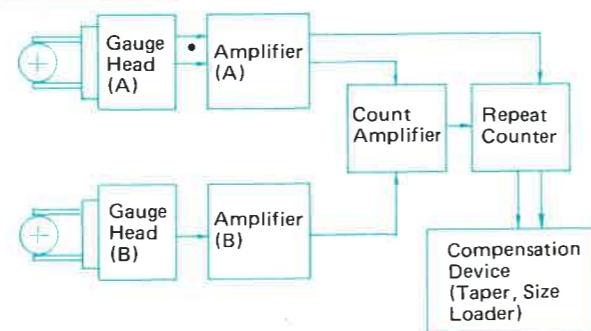
● Important Items

1. Pose of part at the gauging station should be stable (to avoid gauge error)
2. Compensation by signal is aimed to eliminate the error by an accidental reason in mechanical auto-cycle.
3. Parts size before and after dressing are not guaranteed to be identical. (by the wear of diamond tool, wear of blade and other reasons)
4. So, this control requires same range of size tolerance. Or, requires inspection and compensation after dressing.

EXAMPLE

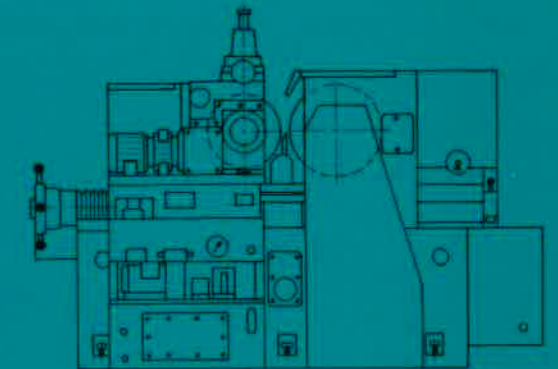


EXAMPLE

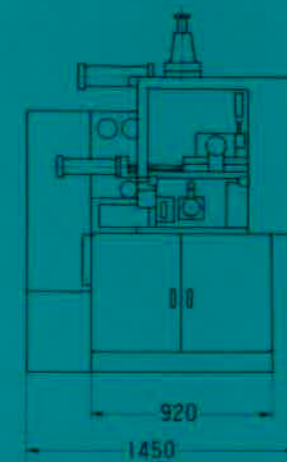
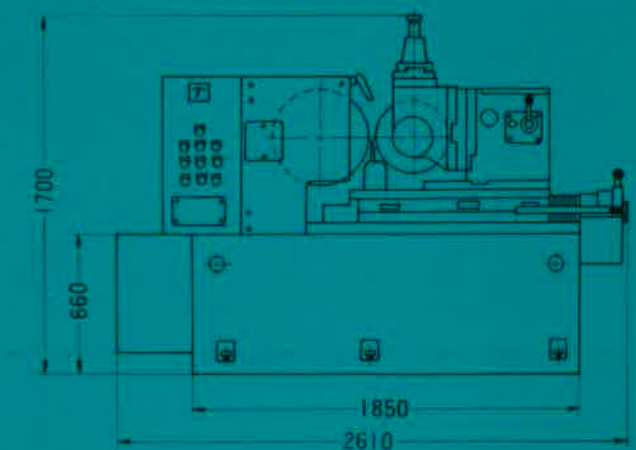


# DIMENSIONS

Rear View

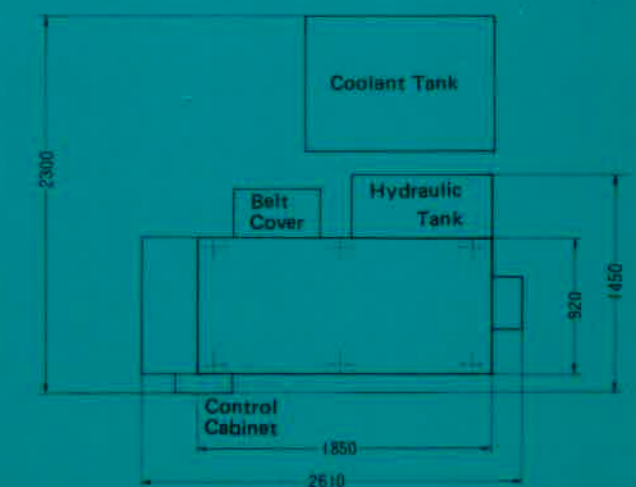


Front View



Side View

Floor Plan



## STANDARD SPECIFICATION

<b>CAPACITY</b>	
Work Diameter	φ2 ~ φ100 mm (φ0.08 ~ φ4")
Max. Infeed Length	200 or 250* mm (8" or 10")
<b>GRINDING WHEEL</b>	
Dimensions	φ610 x 205 x φ304.8 mm (φ24.4 x 8 x φ11.9") φ610 x 255* x φ304.8 mm (φ24.4 x 10.2 x φ11.9")
Surface Speed	45 m/sec or 60* m/sec (147.5 sf/s or 197 sf/s)
Motor Capacity	20 or 30* HP (15 kw or 22.5* kw)
<b>REGULATING WHEEL</b>	
Dimensions	φ355 x 205 x φ177.8 mm (φ13.8 x 8 x φ6.9")
Speed Selection	Mechanical Infinitely Variable Speeds
Motor Capacity	1 HP (0.75 kw)
<b>WHEEL TRUING</b>	
Traverse	Hydraulic Cylinder
Diamond Infeed	Micro Dial
<b>INFEED UNIT</b>	Infeed Hand Wheel graduated in 0.001 mm
<b>FLOOR SPACE</b>	Please refer P. 19
<b>APPROXIMATE WEIGHT</b>	5,500 kg (12,000 lbs)

\* Special type with additional cost.

## STANDARD ACCESSORIES

Motor & Standard Electrical Equipment	1 set
Grinding Wheel & Mount	1 set
Regulating Wheel & Mount	1 set
Coolant Unit	1 set
Hydraulic Unit	1 set
Splash Guard	1 set
Wheel Hanger	1 set
Levelling Bolts and Pads	1 set
Hydraulic Grinding Wheel Truing Unit	1 set
Hydraulic Regulating Wheel Truing Unit	1 set
Standard Tools	1 set

## SPECIAL ACCESSORIES

Thrufeed Workrest
Infeed Workrest
Hydraulic Ejector
Thrufeed Work Support Blade
Infeed Work Support Blade
Grinding Wheel Mount Assemblies & Spacers
Regulating Wheel Mount Assemblies & Spacers
Precision Profile Truing Unit
Wheel Truing Cams (Profile)
Upper Guide Blade
Loading and Unloading Chutes
Diamond Tools (Single, Multi-Points, Bonded, Forming)
Wheel Balancing Stands
Field Balancer
Coolant Separator
Manual Loading & Unloading Device
Automatic Loading Attachments
Automatic Wheel Truing Unit
Push Button Fine Compensating Unit
Automatic Infeed Unit

## SPECIAL DEVICES (Please refer P. 17, P. 18)

Auto-infeed Cycle
Auto-loading Cycle
Auto-dressing Cycle
Push Button Fine Compensation (0.001 mm/push or 0.0005 mm/push)
Auto-taper Control Cycle
Inprocess Gauging Cycle
Postprocess Gauging Cycle

\* All auto-cycle operate with high accuracy and efficiency.

\* All rights to effect changes are reserved.